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Differentrating this expression and also $x_1{}^2+y_1{}^2=r^2$ and eliminating dx_1, dy_1, we get

$$2(x_1-y_1)\left\{\frac{a+b-x_1-y_1}{[(a-x_1)^2+(b-y_1)^2]^2}-\frac{a+c-x_1-y_1}{[(a-x_1)^2+(c-y_1)^2]^2}\right\}$$
$$-\frac{2b(r-a)x_1-[b^2-(a-r^2)]y_1}{[r(a-x_1)^2+r(b-y_1)^2][2br^2+(a^2-b^2-r^2)y_1-2abx_1]}$$
$$+\frac{2c(r-a)x_1-[c^2-(a-r)^2]y_1}{[r(a-x_1)^2+r(c-y_1)^2][2cr^2+(a^2-c^2-r^2)y_1-2acx_1]}=0.$$

From this expression the values of x_1, y_1 that give a maximum can be determined.

11. Proposed by H. W. DRAUGHON, Clinton, Louisiana.

A ribbon, 1 inch wide is wrapped spirally around a right prism, altitude 10 ft., bases of n sides, radius of circumscribed circle, 1 ft., so as to cover the entire convex surface. (1) What is the length of the ribbon? (2) If the ribbon is unwound and kept tense, by a power acting on the lower end, and moving in the plane of the lower base, what will be the length of the curve described by the power?

Solution by G. B. M. ZERR, A. M., Principal of High School, Staunton, Virginia.

Let $ABCD$.... be the projection of the base of the prism on the plane of the paper, O its centre, OA the radius of the circumscribed circle $\angle BOA=\frac{2\pi}{n}$.

$$\angle ABF=\angle BCG=\&c.=\frac{2\pi}{n},\ AB=2r\sin\frac{\pi}{n}\text{ where }r=OA.$$

(1.) $\therefore$ perimeter of base of prism $=2rn\sin\frac{\pi}{n}$.

Now since the ribbon crosses each edge at an inch apart, the length for one revolution $=\sqrt{4r^2n^2\sin^2\frac{\pi}{n}+\frac{1}{144}}$ feet.

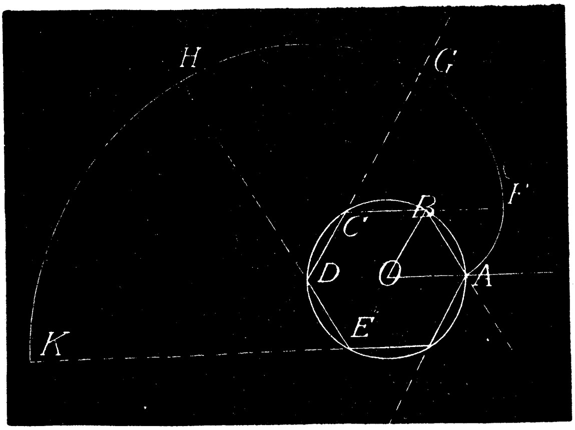
There are in all 120 revolutions, hence,

$$\text{length }=120\sqrt{4r^2n^2\sin^2\frac{\pi}{n}+\frac{1}{144}}=10\sqrt{576n^2\sin^2\frac{\pi}{n}+1}.$$ Since $r=1$, when $n=6$, $l=10\sqrt{(576\times9+1)}=720.07$ feet, and when $n=$ infinity, $n\sin\frac{\pi}{n}=\pi$.

$\therefore$ $l=10\sqrt{(576\pi^2+1)}=754.05$ feet.

(2) Let m be the number of revolutions. Also let $AFGHK$.... be the curve described.

From A to F, $AB=2r\sin\frac{\pi}{n}$ is the radius and $\frac{2\pi}{n}$ the central angle, from F to



G, $FC=2BC=4r\sin\frac{\pi}{n}$ is the radius and $\frac{2\pi}{n}$ the central angle, from G to H, $GD=3CD=6r\sin\frac{\pi}{n}$ is the radius and $\frac{2\pi}{n}$ the central angle and so on. For the nth side or the last side of the first revolution,radius $=2nr\sin\frac{\pi}{n}$, for the last side of second revolution radius$=4nr\sin\frac{\pi}{n}$, for the last side of the mth revolution radius$=2mnr\sin\frac{\pi}{n}$.

Hence without the use of calculus if $s=$ length of path, arc $AF=2r\times\frac{2\pi}{n}\sin\frac{\pi}{n}$, arc $FG=4r\times\frac{2\pi}{n}\sin\frac{\pi}{n}$, arc $GH=6r\times\frac{2\pi}{n}\sin\frac{\pi}{n}$.

$$\therefore\ s=2r\times\frac{2\pi}{n}\sin\frac{\pi}{n}\left\{1+2+3+\ldots.\ (mn-1)\right\}=2r\times\frac{2\pi}{n}\times\sin\frac{\pi}{n}\,\frac{mn(mn-1)}{2}$$

$=2\pi rm(mn-1)\sin\frac{\pi}{n}$. But $r=1$, $m=120$.

$$\therefore\ s=240\pi(120n-1)\sin\frac{\pi}{n}.$$

If $n=6$, $s=271057.248$ feet, if $n=$infinity $s=2(120)^2\pi^2=284245.9361$ feet.

Also solved by *ALFRED HUME* and the *PROPOSER*.

12. Proposed by ISAAC L. BEVERAGE, Monterey, Virginia.

Given the equations $2z^3=x+3z$ and $5z^2=y+2z$. To find $\frac{dy}{dx}$ for $x=0$.

Solution by Professor P. H. PHILBRICK, Lake Charles, Louisiana.

We have $x=2z^3-3z$, and $y=5z^2-2z$. $\therefore dx=(6z^2-3)dz$, $dy=(10z-2)dz$, and $\frac{dy}{dx}=\frac{10z-2}{6z^2-3}$.

But $x=2z^3-3z=z(2z^2-3)=0$. $\therefore z=0$, and $\pm\sqrt{\frac{3}{2}}$.

$\therefore\ \frac{dy}{dx}=\frac{2}{3}$, or $\pm\frac{5\sqrt{6}-2}{6}$, when $x=0$.

Also solved by *Professors BLACK, DRAUGHON, MATZ, SCHEFFER, WHITAKER*, and *ZERR*.

13. Proposed by J. A. CALDERHEAD, Superintendent of Schools, Limaville, Ohio.

A steamer whose curse is due west and speed 10 knots is sighted by another steamer going at 8 knots; what course must the latter steer, so as to cross the track of the former at the least possible distance from her?

Solution by C. W. M. BLACK, A. M., Department of Mathematics, Wilmington Conference Academy, Dover, Delaware.

Let A be the position ot sighting steamer, D of other when sighted, B where A crosses course of D, which by that time has reached C. AE is $CE\perp$ Let $y=CB=CD+DB=CD+DE-BE$. Let $a=$no. hrs. A takes to reach B, and $b=AE$. $\angle EAB=x$, $\angle EAD=\theta$.